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ABSTRACT

The admissable probability measurement (APM) format was used to score a criterion referenced language arts test administered in an inner city junior high school. Its 30 items covered capitalization, punctuation, parts of speech, and sentence analysis. With APM, students indicate their confidence in their answer choice, and guessing is heavily penalized. An appropriate classroom strategy may be chosen for the student's indicated knowledge level: re-education for the misinformed student; advancing to the next level when the student is informed; instruction for the uninformed; and review for the partially informed. A 20-minute session was presented to explain the APM format to the students before the test was administered. Responses were analyzed with the school's microcomputer using the Nova Assessment APM software package. The analysis generated four major outputs: (1) individual knowledge assessment to generate learning prescriptions; (2) item analysis for curriculum design and articulation to feeder schools and programs; (3) clustering of students for effective grade placement; and (4) information to better prepare students to take standardized tests scored in the traditional (right versus wrong) manner. (A detailed case study for one student is presented). (GDC)

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USE OF APM FOR

ASSESSING LANGUAGE ARTS PLACEMENT SKILLS

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ABSTRACT

In this study a criterion referenced language arts placement examination was scored in an admissible probability measurement (APM) format instead of a traditional (right-wrong) scoring format. Due to the influence of guessing, traditional test scoring techniques typically overstate subject matter mastery. By recognizing distortions introduced by guessing and permitting credit for partial information, an APM formatted examination more accurately assesses student knowledge. APM generates information which might be useful to teachers (in terms of knowledge assessment), students (use of information when taking exams and placement), and administrators (in terms of curriculum design and articulation to feeder schools).

Introduction

Placing students into appropriate instructional programs in cumulative subject areas such as language arts and mathematics is a major professional responsibility of teachers that is usually based on standardized test results. Language arts teachers also utilize these tests to ascertain gaps in the knowledge base of their students. This type of assessment is imperative because knowledge gaps can effectively hamper future student learning. Because cognitive development of language skills depends upon cumulative growth of verbal and written skills, accurate assessment of knowledge gaps is especially critical. Depending upon the time available to score exams, knowledge assessment devices have varied from essay type examinations to true- false examinations. (See Figure 1) Presently there seems to be a trend in educational institutions towards the use of multiple forced choice type examinations for evaluating student performance.

A standardized, norm referenced test (NRT) like the Comprehensive Test of Basic Skills (CTBS) is a typical examination used for language arts placement. The CTBS is a nationally administered test in which scores for the tested group are compared with norms established by an original normative group of students. While such tests have legitimate uses in educational assessment, particularly in evaluating regional programs, or comparing groups of students with one another, or for locating potential trouble areas of a

curriculum, they are not very appropriate for individual knowledge assessment. For the purpose of accurate placement of students into appropriate instructional programs, the norm referenced test does not provide teachers with precise information to effectively pinpoint gaps in the knowledge base of students. Furthermore, teachers often complain that these tests are dysfunctional and a waste of time, since the results are usually reported as an undigested list of individual scores (given in percentiles or grade equivalents), and there is usually a large time delay in feedback. Additionally, the test items on these tests are themselves criticized for being either inappropriate or overly refined -- inappropriate because only quantifiable skill areas are measured, and overly refined because the items must be either trivial or esoteric in order to create the desired bell shaped curve.

To address some of the concerns of NRT's, teacher developed criterion referenced testing (CRT) is used. One major benefit of this type of testing is that it encourages teachers to make formulating and evaluating instructional objectives pivotal aspects of the curricular process. If course objectives are clear, then tests can be designed that are directly relevant to the school's instructional program. Unfortunately, CRT testing retains the same right-wrong approach to scoring, encourages guessing and does not provide the teacher with the type of information the student possesses. In short, the information type possessed by student is filtered with present (right-wrong) scoring systems whether they are assessed using an NRT or a CRT.

(See Figure 1)

Essay

Maximum information transmitted
Costly
Subjective in Evaluation
Partial credit for Partial Information

APM
A large amount of information
Objective in Evaluation
Minimal influence of guessing
Some training required

Multiple choice
Objective in Evaluation
Limited information
Distortions due to Guessing

True-False
Efficient
Objective in Evaluation
No Information
Large distortions due to Guessing

Figure 1
The Knowledge Assessment Continuum

The major statistical premise of forced choice (right-wrong) testing is that errors are assumed to be uncorrelated to true knowledge scores and are at random, i.e., the true knowledge score is considered constant for an individual. Stated differently, over an infinite number of tests, the expectation of an individual student observed score is the student's true score. (Lord and Novick, 1968) Tests utilizing this type of testing model cannot distinguish between possible student "information types" such as fully informed, partially informed, misinformed, or uninformed. A unique testing format called admissible probability measurement (APM), based on an information theoretic estimation of knowledge, is

proposed as an alternative scoring procedure. It is suggested that APM not only better assesses the knowledge base of students for appropriate language arts placement, but also provide teachers and administrators with important curricular design information. Research on the traditional test scoring format indicates that forced choice (right-wrong) scoring procedure encourage guessing. Guessing masks a student's true information base, and produces distortions in observed test scores.

> As one researcher has noted, "results show test scores to be overstatements of subject mastery, with larger distortions at the lower achievement levels; this suggests that many inner city programs are being planned and evaluated using data containing large amounts of error." (Bruno and Doscher 1981; verified in Wick, 1982).

Recent advances in test scoring procedures, coupled with the widespread availability of microcomputers technology, now enable language arts teachers to utilize APM testing formats in the classroom. By using APM, the teacher can determine if a student information base is generally misinformed (knows answers wrongly), partially informed (knows answers partly), informed (knows answers correctly), or uninformed (knows nothing of the answer). Students answer each question within a decision theoretic framework that directly matches their response to the actual knowledge they possess on the test item. APM provides test-takers with a response triangle with which they spatially represent (or admit) their confidence (probability) for each answer. (See Figure 2)

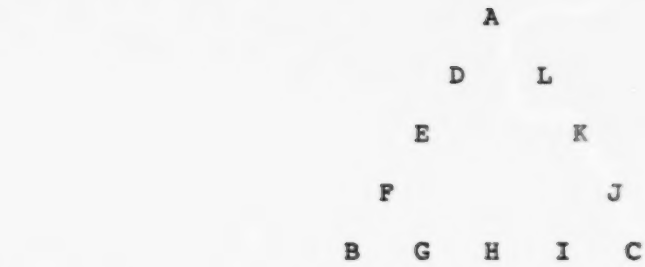
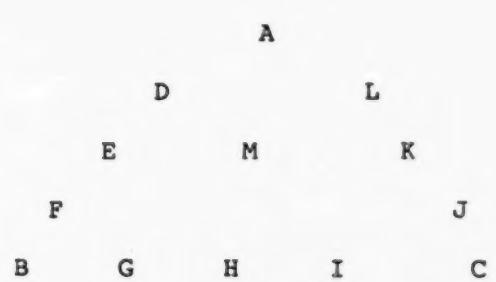


Figure 2
APM Response Triangle

Note each region on the triangle, depending upon its distance from the correct answer, has information theoretic implications concerning a person's knowledge base. Each vertex of the triangle represents one of the response choices, and the points between each vertex indicate the confidence in their choice of answer depending upon their information. Response M indicates total lack of information (or indifference) to the three choices.

Each point on the triangle also represents a point value score depending upon its spatial distance from the correct answer. (see Figure 3)



Possible Scores

A	(24,-76,-76)	H	(-76,9,9)
B	(-76,-76,24)	I	(-76,-19,-11)
C	(-76,24,-76)	J	(-11,16,-76)
D	(19,-76,-11)	K	(9,9,-76)
E	(9,-76,9)	L	(19,-11,-76)
F	(-11,-76,19)	M	(0,0,0)
G	(-76,-11,19)		

Figure 3
Conditional Score Triplets

APM controls for guessing by making the point loss for an incorrect answer so severe that it is in the best interest of a

student to choose points on the triangle that accurately represent their knowledge state rather than guess and risk losing a large amount of points. Depending on the score a student receives on an APM format test, the knowledge base covered by the examination can be classified as being misinformed, partially informed, informed or uninformed. Each of these types of student information has an implication for classroom remediation. The following classroom strategy is suggested: (see Figure 4)

Student Information Type		Classroom Instructional Remedy or Strategy
1. Misinformed	-76	Reeducation
Nearly misinformed	-11	
2. Informed	+19	Advance to next level
Well informed	+24	
3. Uninformed	0	Instruction
4. Partially informed	-9	Review

Figure 4
APM Analysis and Instructional Strategy

APM scoring techniques may be used with students at any grade level, provided they understand the idea of matching their response with their actual information. For teacher convenience, an APM test scoring software package is available from Nova Assessment Systems which enable classroom teachers with access to an Apple microcomputer to score and quickly generate tests for classroom use. Scores can be entered by an aide into the microcomputer, or tests can be optically scanned with R Scantron data terminals. Furthermore, teachers with access to microcomputer labs can have students take APM tests via the microcomputer and receive immediate feedback.

The Study

To demonstrate the efficacy of employing an APM formatted test in assessing student language skills, a criterion referenced language arts placement test was administered to students in an instructional resource center at an inner city junior high school. This particular placement test was designed to measure competency in four areas of language arts: capitalization, punctuation, parts of speech, and sentence analysis. There were thirty questions on the examination, with each question designed to test mastery of a discrete skill. A twenty minute instructional period was allocated for explaining the APM test format and how to select the "best" response option depending upon information. The class responses were analyzed with the school's microcomputer using the Nova Assessment APM software package. A detailed analysis of individual and class

results were then generated for use by the lab instructors in designing individualized student learning prescriptions. (see Figure 5) When filled at the school's learning center, the APM assessments can help students to take an affirmative role in their own education and learning.

The major outputs of the APM analysis for language arts placement were:

1. individual knowledge assessment to generate learning prescriptions to be filled at the learning center.
2. item analysis for curriculum design and articulation to feeder schools and programs.
3. clustering of students by APM information content for effective grade placement.
4. value of information analysis to better prepare students to take standardized tests scored in the traditional manner.

Figure 5
APM Outputs

The reports generated by the Nova APM software package provide a wealth of information for use by both the classroom teacher and the administrator. One of the major outputs mentioned above is the assessment of an individual students' knowledge base. (see Figure 5) The detailed information then forms the basis for generating learning prescriptions for these students. To illustrate this application, an example of a learning prescription of a student, Maurice, from the tested class will be highlighted. (see Figure 6)

STUDENT NAME : MAURICE
APM ANALYSIS NUMBER... 10

FAIES TEST

ITEM ANALYSIS

APM TYPE	FREQUENCY	PERCENTAGE
MISINFORMED ITEMS - (MI)	13	0.43
NEAR MISINFORMED - (NM)	0	0.0
UNINFORMED ITEMS - (UN)	1	0.03
PART INFORMED - (PI)	0	0.0
WELL INFORMED - (WI)	0	0.0
FULLY INFORMED - (FI)	16	0.53

TOTAL APM SCORE	-604.00
SCALED APM SCORE	1676.00
PERCENTAGE OF MAXIMUM	0.56

TRADITIONAL SCORE	16.30
PERCENTAGE TRAD SCORE	0.54

INFORMATION ANALYSIS-HOW STUDENTS VALUE OR UNDERVALUE
THEIR INFORMATION

FOR ITEMS ANSWERED-FULLY INFORMED WITH ABC RESPONSES
YOU SHOULD EXPECT 100% OF THE RESPONSES TO BE CORRECT

WRONG	11
CORRECT	16
TOTAL	27
PCT	0.59

AVERAGE OVERALL KNOWLEDGE ASSESSMENT BASED UPON PERCENT OF INFORMATION
TRANSMITTED FOR EACH CLASSIFICATION---PMISINFR

USE OF INFORMATION IN TAKING THE EXAMINATION---OVERVAL

ITEM	ANSWER	RESPSE	APM EVAL	SCORE
1	B	B	INFORMED	24.00
2	A	A	INFORMED	24.00
3	A	A	INFORMED	24.00
4	B	K	MISINFOR	-76.00
5	C	C	INFORMED	24.00
6	A	C	MISINFOR	-76.00
7	C	B	MISINFOR	-76.00
8	B	L	MISINFOR	-76.00
9	B	M	UNINFORM	0.0
10	C	A	MISINFOR	-76.00
11	B	B	INFORMED	24.00
12	C	A	MISINFOR	-76.00
13	C	B	MISINFOR	-76.00
14	A	A	INFORMED	24.00
15	C	C	INFORMED	24.00
16	A	A	INFORMED	24.00

17	C	C	INFORMED	24.00
18	C	C	INFORMED	24.00
19	B	B	INFORMED	24.00
20	A	A	INFORMED	24.00
21	B	B	INFORMED	24.00
22	C	C	INFORMED	24.00
23	A	A	INFORMED	24.00
24	C	C	INFORMED	24.00
25	B	A	MISINFOR	-76.00
26	C	C	MISINFOR	-76.00
27	B	A	MISINFOR	-76.00
28	C	A	MISINFOR	-76.00
29	B	A	MISINFOR	-76.00
30	C	A	MISINFOR	-76.00

Figure 6
APM Individual Student Output

Maurice was identified as being partly misinformed in his overall APM assessment. The printout evaluated the information he possessed on each discrete item on the test. The teacher was able to identify eighteen skills which Maurice had already mastered. On these skills he was advanced to the next level of difficulty. Conversely, skill areas for which this student was misinformed were pinpointed, and a learning prescription involving reeducation was written. Maurice was then able to take this prescription to the school's instructional resource center to be filled. With this procedure, the student can take more responsibility for learning. With APM, students can also begin to systematically build upon a firm knowledge base and with appropriate feedback take a more affirmative view and responsibility for their own learning. The "affirmative" use of testing permits teachers to assume the professional role of coach and doctor by prescribing precise "learning prescriptions" depending upon the results of the APM assessment.

In addition to knowledge assessment, APM also provides an analysis of a student's use of information when taking the examination. The value of information analysis refers to the degree to which students value or overvalue the information in their knowledge base. This assessment is made by examining the percentages correct when A-B-C "100% certain" responses are used. If the student is less than 80% correct in choosing these responses, the student is identified as overvaluing his/her information. In Maurice's case, he chose an A-B-C answer incorrectly in eleven out of twenty seven questions, for a percentage of 59%. Consequently, he was identified as overvaluing his information and might be still guessing. The teacher utilized this particular information about Maurice to prescribe learning activities in various test taking strategies. Thus, by identifying those who frequently guess, APM allows the teacher to prescribe remediation (how to use information) which can better prepare students to take standardized exams scored in the traditional manner.

In addition to individual student information, teachers also receive a class APM item analysis. It is in this area that APM perhaps has its greatest potential impact for learning. Children vary each year in terms of ability, study habits, subject matter preparation, etc, yet the district-wide curriculum remains fixed and rigid. APM can and is being effectively used as a tool to diagnose the curricular needs of a given set of students. For example, degradation of a student knowledge base over a summertime period could be ascertained

with this procedure and time set aside for review in specific curriculum areas.

The item APM analysis for the examination used in this study indicated that there were four discrete skill areas for which the class as a whole was misinformed. (see Figure 7) The teacher then utilized this information to "fine tune" the curriculum so as to place special lesson emphasis in these knowledge content areas.

APM ANALYSIS FOR EXAMINATION - FREQ/PERCENTAGE

ITEM	FULL	WELL	PART	UNINF	NEAR M	MISINF	ASSESSMENT
1	20	0	0	0	0	1	
1	0.29	0.0	0.0	0.0	0.0	0.05	INFORMED
2	20	0	0	0	0	1	
2	0.95	0.0	0.0	0.0	0.0	0.05	INFORMED
3	21	0	0	0	0	0	
3	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
4	12	3	1	1	0	4	
4	0.57	0.14	0.05	0.05	0.0	0.19	INFORMED
5	17	1	0	1	0	2	
5	0.81	0.05	0.0	0.05	0.0	0.10	INFORMED
6	15	0	1	0	1	4	
6	0.71	0.0	0.05	0.0	0.05	0.19	INFORMED
7	20	0	0	0	0	1	
7	0.95	0.0	0.0	0.0	0.0	0.05	INFORMED
8	18	1	0	1	0	1	
8	0.86	0.05	0.0	0.05	0.0	0.05	INFORMED
9	17	1	1	2	0	0	
9	0.81	0.05	0.05	0.10	0.0	0.0	INFORMED
10	19	0	0	0	0	2	
10	0.90	0.0	0.0	0.0	0.0	0.10	INFORMED
11	19	1	1	0	0	0	
11	0.90	0.05	0.05	0.0	0.0	0.0	INFORMED
12	1	2	1	4	0	13	
12	0.05	0.10	0.05	0.19	0.0	0.62	MISINFORMED
13	10	1	2	4	2	2	
13	0.48	0.05	0.10	0.19	0.10	0.10	INFORMED
14	21	0	0	0	0	0	
14	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
15	21	0	0	0	0	0	
15	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
16	21	0	0	0	0	0	
16	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
17	21	0	0	0	0	0	
17	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED

18	17	0	2	0	0	0	
18	0.18	0.0	0.10	0.0	0.0	0.10	INFORMED
19	15	0	1	1	0	3	
19	0.71	0.0	0.05	0.05	0.0	0.14	INFORMED
20	21	0	0	0	0	0	
20	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
21	16	0	0	0	0	4	
21	0.76	0.0	0.0	0.0	0.0	0.19	INFORMED
22	15	0	1	0	1	4	
22	0.71	0.0	0.05	0.0	0.05	0.19	INFORMED
23	21	0	0	0	0	0	
23	1.00	0.0	0.0	0.0	0.0	0.0	INFORMED
24	15	1	0	1	1	3	
24	0.71	0.05	0.0	0.05	0.05	0.14	INFORMED
25	3	0	3	0	1	14	
25	0.14	0.0	0.14	0.0	0.05	0.67	MISINFORMED
26	11	1	1	0	0	8	
26	0.52	0.05	0.05	0.05	0.0	0.38	INFORMED
27	5	1	3	0	2	10	
27	0.24	0.05	0.14	0.0	0.10	0.48	MISINFORMED
28	10	1	0	1	2	7	
28	0.48	0.05	0.0	0.05	0.10	0.33	INFORMED
29	4	0	2	2	0	13	
29	0.19	0.0	0.10	0.10	0.0	0.62	MISINFORMED
30	12	0	1	0	1	7	
30	0.57	0.0	0.05	0.0	0.05	0.33	INFORMED

Figure 7
APM Curriculum Analysis

Moreover, school administrators can utilize APM analysis to improve curricular articulation from feeder schools and to higher level schools. By examining the item analysis of an APM formatted test given district-wide, administrators can quickly assess curricular strengths and weaknesses of particular feeder schools. With this information, administrators can more

accurately hold feeder schools "accountable" for the learning of their students and can arrange for appropriate inservice programs. Thus, APM accommodates the "fine-tuning" of curriculum at both the classroom and district levels.

Finally, a sorted class roll book of students taking APM is generated. The software program alphabetically sorts tested students and lists their APM score, traditional score, evaluation of use of information and knowledge assessment. A teacher can then readily use these evaluations to cluster students by their APM information content. As an example, in the English placement test used in this study, students were "clustered" into three groups--well informed, partly informed, and the uninformed. (see Figure 8) The teacher used these three clusters to organize small group instruction for students with similar knowledge content. Similarly, such "clusters" could be used for more effective grade placement of new students.

SORTED CLASS ROLL BOOK OF STUDENT TAKING APM

STUDENT	APM SCORE	TRAD SCORE	USE OF INF	KNOWLEDGE ASSESSMEN	APM SC
1 BERTHA	0.97	0.92	GOOD	INFORMED	2925.
2 JOSE	0.93	0.85	GOOD	WELLINFR	2778.
3 BERTA	0.90	0.85	GOOD	WELLINFR	2690.
4 LEROY	0.89	0.87	GOOD	WELLINFR	2670.
5 JAMES	0.88	0.77	GOOD	WELLINFR	2635.
6 QUENTIN	0.86	0.77	GOOD	WELLINFR	2588.
7 RAFAEL	0.86	0.83	GOOD	WELLINFR	2570.
8 TIMOTHY	0.85	0.80	GOOD	PARTINFR	2540.
9 MARLENE	0.83	0.83	GOOD	PARTINFR	2500.
10 TRAVELL	0.82	0.72	GOOD	PARTINFR	2465.
11 NICOLE	0.82	0.80	GOOD	PARTINFR	2460.
12 DANIEL	0.81	0.77	GOOD	PARTINFR	2465.
13 SANDRA	0.81	0.71	GOOD	PARTINFR	2419.
14 LAKECIA	0.78	0.75	OVERVAL	PARTINFR	2352.
15 LESLIE	0.78	0.76	OVERVAL	PARTINFR	2350.
16 ALEJO	0.77	0.77	OVERVAL	PARTINFR	2300.
17 CARMEN	0.77	0.77	OVERVAL	PARTINFR	2300.
18 DREON	0.75	0.72	OVERVAL	PARTINFR	2255.
19 DEMETRI	0.73	0.72	OVERVAL	UNINFORM	2195.
20 WORRELL	0.70	0.69	OVERVAL	UNINFORM	2095.
21 MAU	0.56	0.54	OVERVAL	PMISINFR	1676.

Figure 8
APM Sorted Class Roll Book

Despite the classroom advantages of the APM format, there are also a number of limitations which lessen its classroom effectiveness. The first limitation is that APM represents a radical departure from present testing practices. As a consequence, some inservice training of school personnel may be required to ensure that the APM procedure is understood and effectively used. A second limitation is related to this first one. A sizeable minority of students in the tested junior high class was not willing to deviate from the traditional testing format. These students may not have thoroughly understood the format and the payoff for using all the available response options. The normal point maximizing behavior of students insure

that if APM is effectively communicated, student responses for each item will match their information. Teachers may have to spend a considerable amount of time and effort at the outset to make students aware of how an APM formatted test is structured.

Nevertheless, APM's use in the classroom has a number of positive implications for educators. One of the most important benefits of APM is that students seem to enjoy taking tests where they are given partial credit for partial knowledge. The majority of students tested clearly understood the payoff in using all the available response options to maximize their individual scores. They felt less threatened in this testing situation because they were not forced to choose an answer as with the traditional test. As a consequence, the students felt more motivated and seemed to suffer from less test anxiety. This lessening of test anxiety and increased motivation may be significant psychological benefits of APM deserving further research.

A second benefit of APM is that with guessing minimized, it more accurately assesses a student's knowledge base than do traditional testing formats. This increased accuracy of assessment allows for more effective placement of language arts students into appropriate instructional programs. Better placement of students will hopefully lead to an improvement in the quality of education in our nation's schools.

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